DOCUMENT RESUME

ED 058 249 TM 000 959

AUTHOR	Moodie, Allan G.; Robinson, T. E.
TITLE	An Evaluation of Elementary Science Programs.
INSTITUTION	Vancouver Board of School Trustees (British Columbia).
REPORT NO	RR-71-13
PUB DATE	Jun 71
NOTE	20p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	Cognitive Measurement; *Comparative Analysis; Elementary Schools; *Elementary School Science; Logical Thinking; *Program Effectiveness; *Program Evaluation; Science Curriculum; *Science Education; Science Instruction; Scientific Concepts

ABSTRACT

The Test of Logical Thinking in Science and tape recordings and notes from a scientific inquiry lesson were used to evaluate the relative effectiveness of the regular and new science programs in developing scientific thinking among elementary school pupils. The findings, limited by sample size and short-term experimental design, indicated that the new program worked at least as well as the regular program. A lesson outline is included, and a copy of the instrument is contained in TM 000 960. (DLG)

ED 058249

RESEARCH REPORT

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEH REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

An Evaluation of Elementary Science Programs

June, 1971.

A. G. Moodie
and
T. E. Robinson

Research Report 71-13

Department of Planning and Evaluation
Board of School Trustees
1595 West 10th Avenue
Vancouver 9, B. C.

TM 000 959 - 970

AN EVALUATION OF ELEMENTARY SCIENCE PROGRAMS

June, 1971.

A. G. Moodie

and

T. E. Robinson

Research Report 71-13

Department of Planning and Evaluation
Board of School Trustees,
1595 West 10th Avenue,
Vancouver 9, B. C.

AN EVALUATION OF ELEMENTARY SCIENCE PROGRAMS

Introduction

The purpose of this study was to determine the relative effectiveness of the regular and new science programs in developing scientific thinking among pupils of the elementary school.

Research Sample

Principals of Begbie, Maquinna, Nootka and Selkirk Elementary Schools were asked to provide one class of Grade VI pupils for the research study. Grade VI pupils in two of these arbitrarily selected schools had studied the regular science program while the other two classes were following the new science program. (Although the new science program will be implemented in all elementary schools throughout British Columbia by September, 1972, teachers at the present time have the option of using either the regular or new science programs.)

Research Study

For this study the Science Coordinator, Mr. Tom Robinson, presented separately to each class a scientific inquiry lesson which was adapted from the Teacher's Guide on Relativity in the Science Curriculum Improvement Study.[1] An outline of Mr. Robinson's lesson on relativity appears in Appendix A. An independent observer from the Planning and Evaluation Department tape-recorded and made notes of the children's responses to Mr. Robinson's questions.

[1] Teacher's Guide on Relativity, Science Curriculum Improvement Study (Lexington, Massachusetts: D. C. Heath and Company, 1968).

In the next science period after Mr. Robinson's lesson, each classroom teacher administered the Test of Logical Thinking in Science which had been prepared by the Planning and Evaluation Department. A copy of the 30-minute test appears in Appendix B. All tests written by the Research sample were marked at the office of the Vancouver School Board.

Results of the Research Study

An analysis of tape-recordings and notes made by the independent observer did not reveal significant differences in the quality of pupils' responses. However, there was a quantitative difference in response to the question on whether a boy was moving if he was sitting motionless in a wagon being pulled by a dog. In the two classes with the new science program a total of 42% of the pupils indicated the correct response compared to 23% of the pupils studying the regular science program.

There was no statistically significant difference between the two groups in the number of correct answers for the 18 multiple-choice questions on the Test of Logical Thinking in Science, although pupils in the regular science programs had received slightly higher scores. As the test was designed to challenge the reasoning abilities of pupils through novel problem situations, most scores in both groups were relatively low.

For the last two open-ended questions where one mark was given for each correct response explaining how gravity helps or hinders man, there was a significant difference between the two groups (see Table I). Pupils in the new science program provided more correct responses on the average (statistically significant at the .01 level) than pupils in the regular science program.

Conclusion

The findings of this study with its limited sample size and short-term experimental design showed that scientific thinking and reasoning is promoted in the new science program at least as well as that in the regular science program.

ACKNOWLEDGMENT

The Department of Planning and Evaluation gratefully acknowledges the cooperation and assistance received from:

(1) the principals of Begbie, Maquinna, Nootka and Selkirk Elementary Schools,

(2) the Grade VI science teachers who administered the Test of Logical Thinking in Science, and

(3) the Science Coordinator, Mr. Tom Robinson, who conducted the scientific inquiry lesson on relativity.

TABLE I: ANALYSES BY "t" TEST OF RAW SCORES FOR PUPILS IN THE NEW AND REGULAR ELEMENTARY SCIENCE PROGRAMS

	TEST OF LOGICAL THINKING IN SCIENCE			
	Multiple-Choice Questions		Open-Ended Questions	
	New Program	Regular Program	New Program	Regular Program
Number of Subjects	68	52	68	52
Mean Score	6.3	6.8	2.2	1.3
Standard Deviation	1.9	2.6	1.6	1.1
Difference Between Means	− 0.5		+ 0.9	
"t" Value	1.14 (n. s. d.)		3.57**	

Legend: n. s. d. -- no significant difference
** significant at the .01 level

APPENDIX A

LESSON OUTLINE ON RELATIVITY

ELEMENTARY SCIENCE EVALUATION (NON-MANIPULATION)
S.C.I.S. RELATIVITY UNIT

Relative Position and Motion

Basic Concept -- that the position and motion of an object can only be perceived, described and recognized with reference to other objects.

The unit demands that the student think critically, interpret evidence and work independently.

1. Position - time approximately 10 minutes

   1) Children will be asked to describe teacher's location then a variety of objects in the classroom.

   2) The class will be asked to assist the teacher in giving instructions. He wants them to face the windows but he is not permitted to use the word "window". What can he say to them?

   Observations

   1) The children should begin relating the teacher's and object's position to reference points.
   The success of their "position locating" will depend upon the precise use of terms.

   2) Solutions will use abstracts. Examples, compass points, clock face.

2. Motion

   The class will be told a rather involved story involving the retention of numerical and colour components. Examples, 13 blue steps and two protagonists, Henry and his mother.

   Henry is in motion, being pulled in a wagon by his dog. His mother is the observer.

   Henry claims that he is not moving, his mother sees his motion.

   The story is designed to set up controversy among the class.

   No solution to the problem will be given.

   The class is then asked to imagine that they are on a magic bus. No windows, no doors. Is the bus moving? How could it be proved?

Observations

The students are asked to decide whether Henry moved or not. Ideally they will make reference to the observer. However, they will usually relate Henry's experience to their own experiences.

The magic bus becomes more magical as the teacher eliminates physical stimuli from the situation. Proof given by the students could be motion felt, sound of motor, sound of wind, etc.

The ideal--someone outside watches the bus.

APPENDIX B

TEST OF LOGICAL THINKING IN SCIENCE

TM 000 960

TEST OF LOGICAL THINKING IN SCIENCE

Name_____ School_____

ED 058250

Directions: Please print the letter of the best response in the spaces provided for questions 1 - 18. For questions 19 and 20 you may write your answers on the lines provided.

Time Limit: 30 minutes

EXAMPLE: Our earth is a :

A. star
B. planet
C. meteor
D. comet
E. satellite

Answer: B

1. A Vancouver "quack" doctor claims that he has discovered a cure for the common cold.

Which of the following procedures do you think would be the best one to begin an investigation to establish the truth of the doctor's claim?

A. Ask the "quack" doctor to supply his data with particular emphasis on his records over a period of years.
B. Send samples of the substance to doctors all over the country with the request that they test it on their patients who have colds but with extreme caution.
C. Establish two groups of rats which have colds and give the drug to the rats in one group but not to the rats in the other group.
D. Establish two groups of people who all have colds and give the drug to one group and a neutral substance to the other group.

1. ____

2. If the following figures were arranged in a logical order allowing X to be the first one and Y the last one, which of the figures would

ED 058250

Name _____ School _____

Directions: Please print the letter of the best response in the spaces provided for questions 1 - 18. For questions 19 and 20 you may write your answers on the lines provided.

Time Limit: 30 minutes

EXAMPLE: Our earth is a :

A. star
B. planet
C. meteor
D. comet
E. satellite

Answer: B

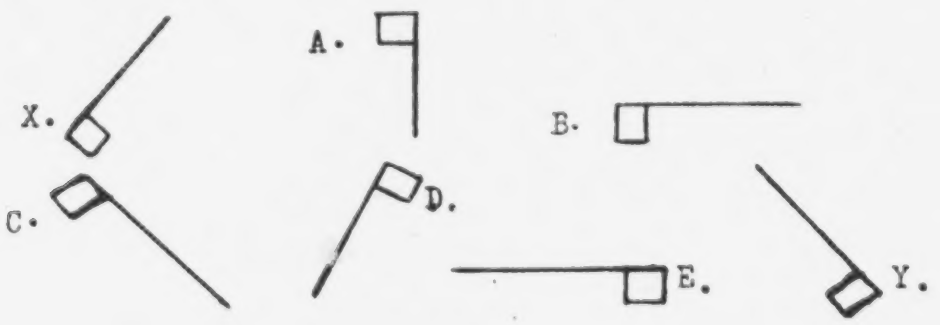
1. A Vancouver "quack" doctor claims that he has discovered a cure for the common cold.

Which of the following procedures do you think would be the best one to begin an investigation to establish the truth of the doctor's claim?

A. Ask the "quack" doctor to supply his data with particular emphasis on his records over a period of years.
B. Send samples of the substance to doctors all over the country with the request that they test it on their patients who have colds but with extreme caution.
C. Establish two groups of rats which have colds and give the drug to the rats in one group but not to the rats in the other group.
D. Establish two groups of people who all have colds and give the drug to one group and a neutral substance to the other group

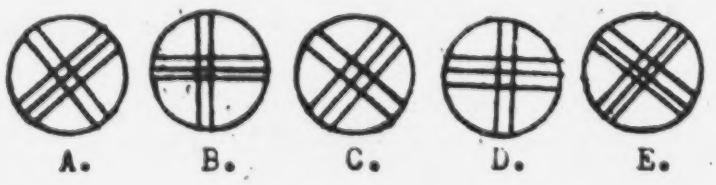
1. ____

2. If the following figures were arranged in a logical order allowing X to be the first one and Y the last one, which of the figures would you place in the middle position.



2. ____

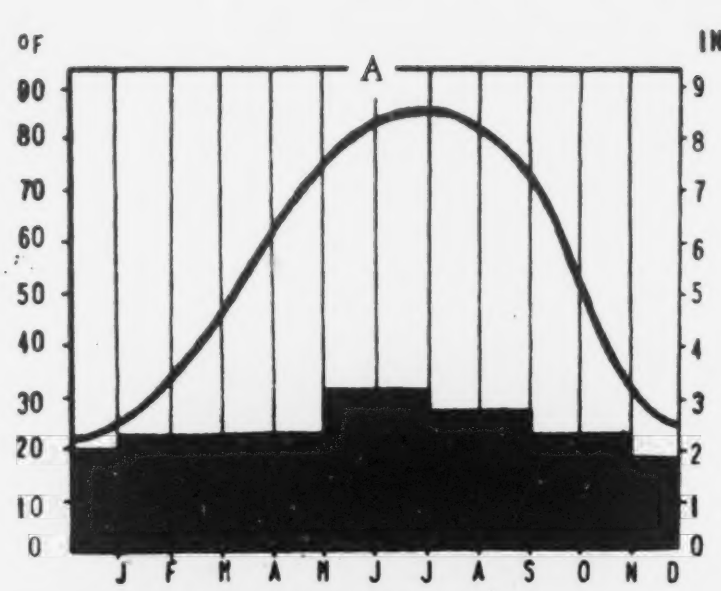
3. Which picture is most different?

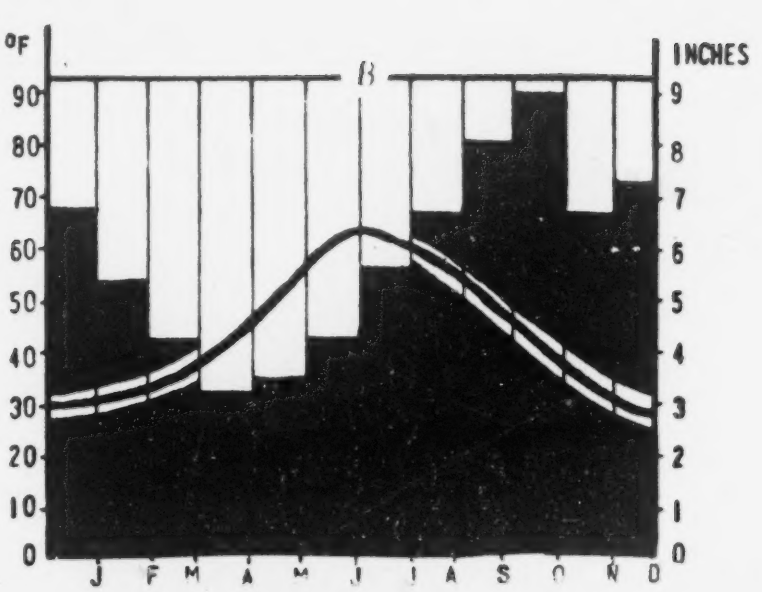


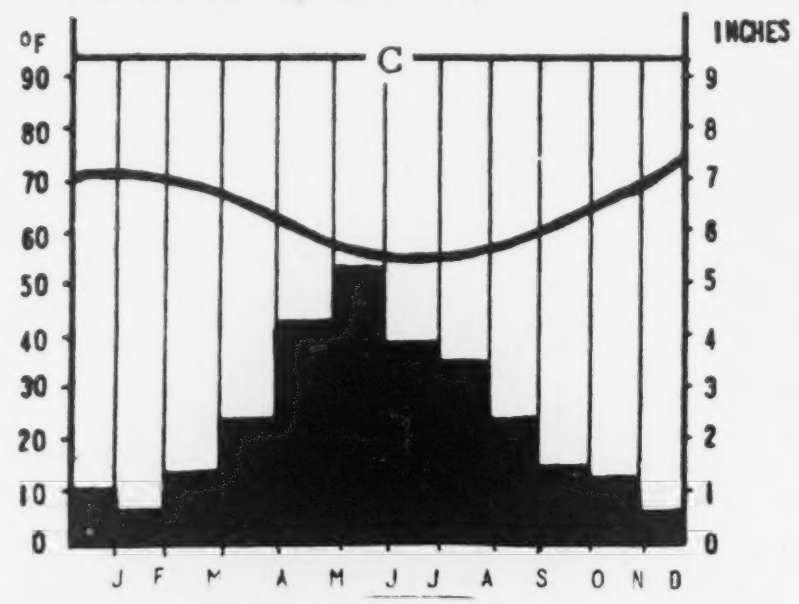
3. ____

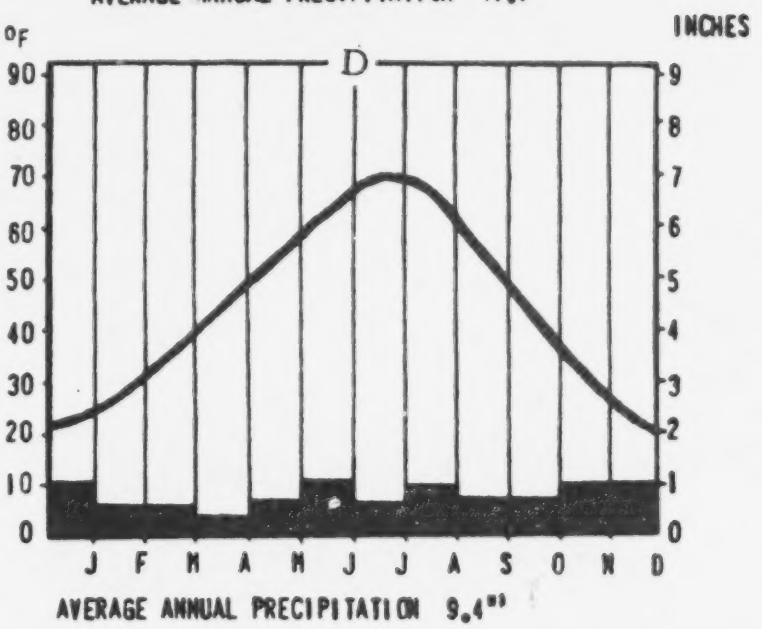
TM 000 960

CLIMATIC GRAPHS





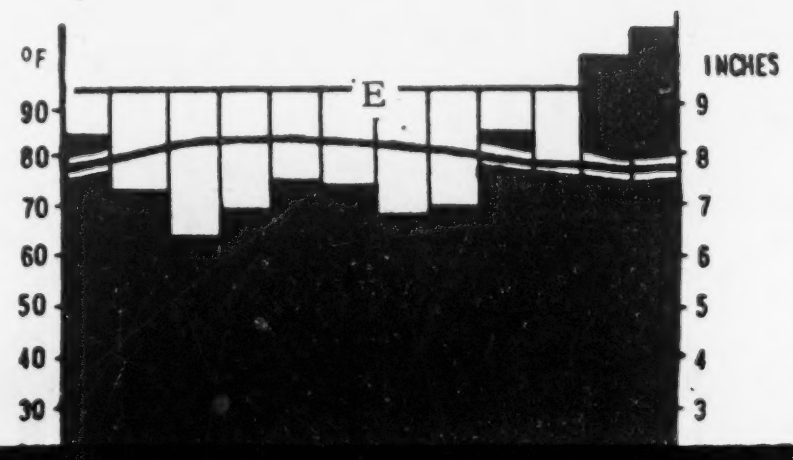




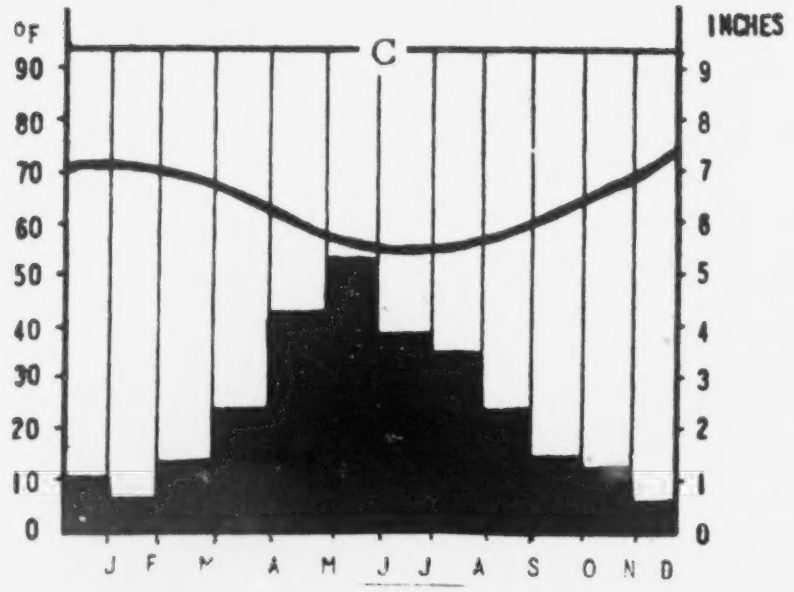
4. Which graph represents the area with the smallest temperature range? 4. _____

5. Which graph represents a location in the Southern Hemisphere? 5. _____

6. Which graph represents the place with the greatest extremes

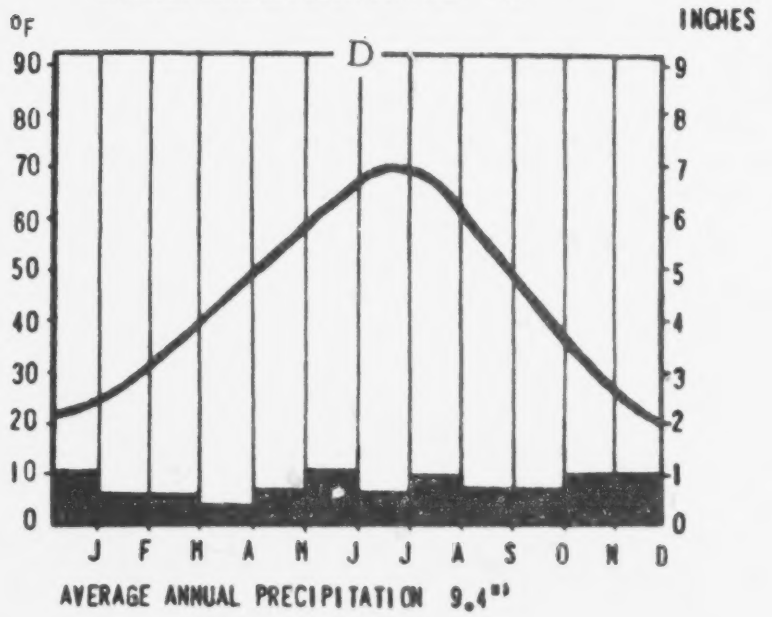


AVERAGE ANNUAL PRECIPITATION 30.7"



AVERAGE ANNUAL PRECIPITATION 26.0"

AVERAGE ANNUAL PRECIPITATION 71.1"



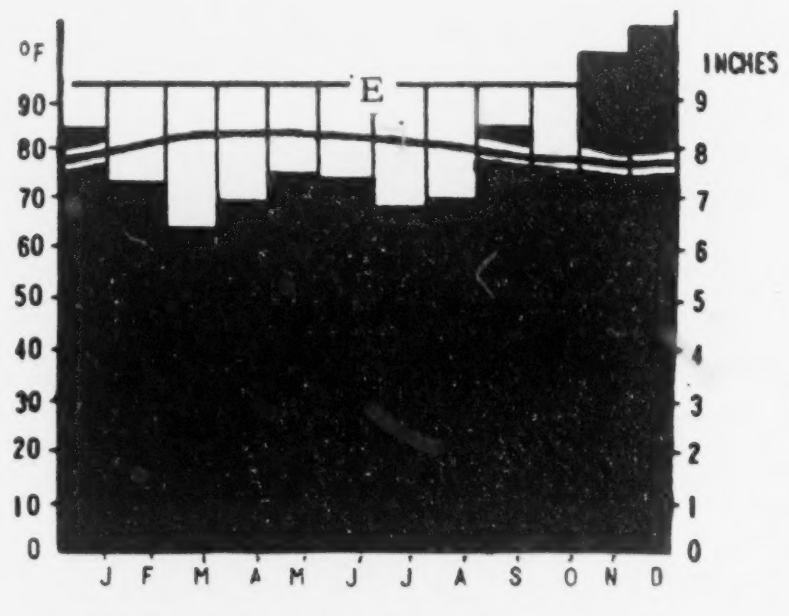
AVERAGE ANNUAL PRECIPITATION 9.4"

4. Which graph represents the area with the smallest temperature range? 4. _____

5. Which graph represents a location in the Southern Hemisphere? 5. _____

6. Which graph represents the place with the greatest extremes of temperature? 6. _____

7. Which graph represents most the place similar to Vancouver's climate? 7. _____



AVERAGE ANNUAL PRECIPITATION 92"

8. Astronauts visiting another planet experienced no twilight and during daylight hours the sky appeared black. From this information scientists would probably conclude that:

A. light was completely reflected from the planet's atmosphere.
B. the atmosphere of the planet absorbed light rays.
C. the light rays arriving at the planet were different from those on earth.
D. there was little or no atmosphere surrounding the planet.

8. _____

9. In the following series, one number has been omitted. Indicate where the missing number should go:

3 7 ↑A 10 ↑B 14 ↑C 17 ↑D 21 ↑E 28 31

9. _____

15

Will we ruin the out-of-doors for our children?

Look at the editorial cartoon above:

Look at the editorial cartoon above:

Indicate whether you consider each of the following statements:

A. Entirely acceptable

B. Partially acceptable

C. Unacceptable

D. You require more information in order to make a valid decision.

10. The man is the boy's father. 10._____

11. The man is probably thinking "How things have changed in my lifetime". 11. _____

12. The modern city is doing away with the pioneering spirit. 12. _____

13. The future of man's environment looks very bleak. 13. _____

14. The picture illustrates environmental pollution. 14. _____

15. When carbon dioxide gas is bubbled into clear lime water the lime water turns milky. (i. e. turns white like milk and you cannot see through it.)
When an unidentified Gas X is bubbled through limewater, the limewater turns milky.

From these data you may conclude:

A. Gas X is pure carbon dioxide.
B. Gas X contains some carbon dioxide.
C. Gas X reacts with limewater in the same way as carbon dioxide.
D. None of the above.

15. _____

16. A missionary reported that the root of a plant much like the Rauwolfia plant had been used by an African witch doctor to cure him of a serious illness.

Which of the following procedures would be most appropriate in a preliminary investigation of the medicinal properties of this plant?

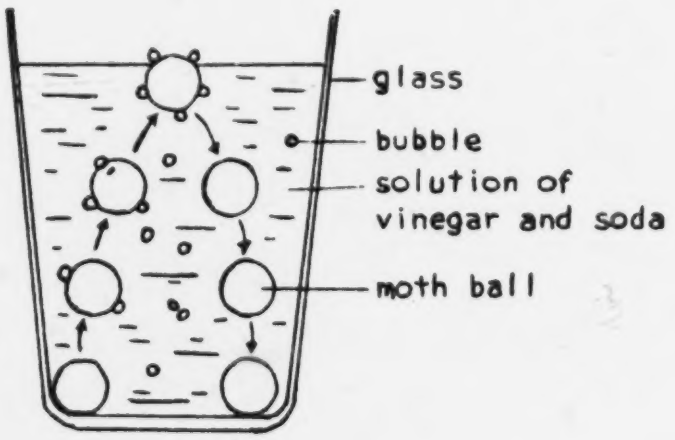
A. Administer portions of the plant to a group of human beings, with appropriate controls, and record the effects.
B. Select two groups of rats as experimental and control groups to test the effects of the plant.
C. Send purified samples of the drug to hundreds of physicians throughout the world to assure an adequate sample.
D. Cross the plant with Rauwolfia to determine how closely these two plants are related.

PROBLEM:
Given below is a partial report of a classroom demonstration. Use this information to answer the question.

METHOD:

1. Fill a tall glass with water.
2. Add two tablespoons of vinegar.
3. Add and dissolve one-half teaspoon bicarbonate of soda.
4. Wait until bubbles begin to form, then drop in one mothball.

DIAGRAM:



OBSERVATIONS: (not in correct order)

1. Mothball sinks to bottom of glass.
2. Bubbles are released from mothball.
3. Mothball rises to surface.
4. Bubbles cling to mothball.
5. Mothball sinks to bottom of glass.

18. A logical sequence for the observation is:

D. None of the above.

15. _____

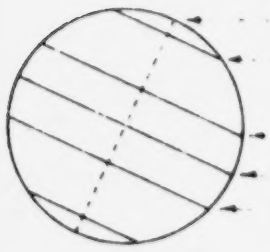
16. A missionary reported that the root of a plant much like the Rauwolfia plant had been used by an African witch doctor to cure him of a serious illness.

Which of the following procedures would be most appropriate in a preliminary investigation of the medicinal properties of this plant?

A. Administer portions of the plant to a group of human beings, with appropriate controls, and record the effects.
B. Select two groups of rats as experimental and control groups to test the effects of the plant.
C. Send purified samples of the drug to hundreds of physicians throughout the world to assure an adequate sample.
D. Cross the plant with Rauwolfia to determine how closely these two plants are related.

16. _____

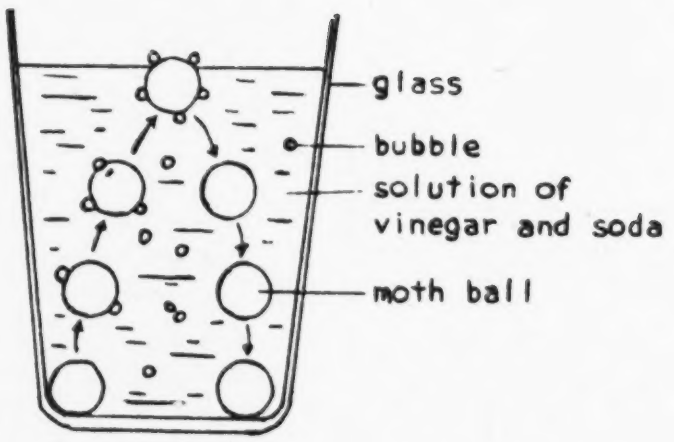
The following diagram shows five different locations on the surface of the earth.


A. The North Pole, or 90 N.
B. The Arctic Circle, or 66.5 N.
C. The Tropic of Cancer, or 23.5°N.
D. The equator, or 0°.
E. The Tropic of Capricorn, or 23.5°S.

17. Which letter designates the location where a person can move in only one direction on the earth's surface?

17. _____

DIAGRAM:



OBSERVATIONS: (not in correct order)

1. Mothball sinks to bottom of glass.
2. Bubbles are released from mothball.
3. Mothball rises to surface.
4. Bubbles cling to mothball.
5. Mothball sinks to bottom of glass.

18. A logical sequence for the observation is:

A. 2 1 4 3 5
B. 1 4 3 2 5
C. 4 1 2 3 5
D. 5 2 3 4 1

18. _____

19

19. List ways in which gravity may help man.

20. List ways in which gravity may hinder man.

20. List ways in which gravity may <u>hinder</u> man.